Array Development and Aeroacoustic Research at NASA ARC

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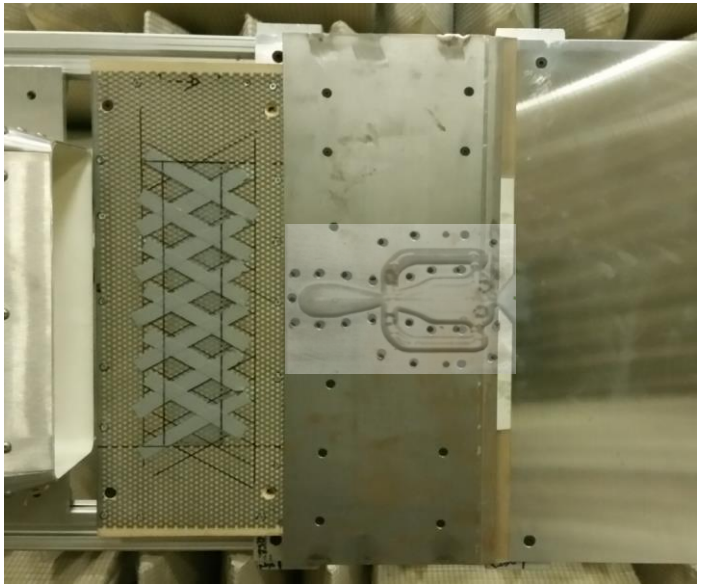
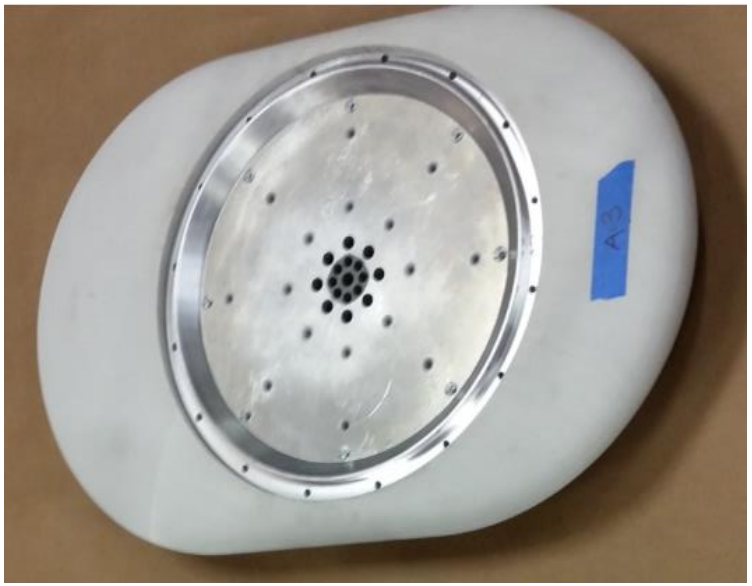


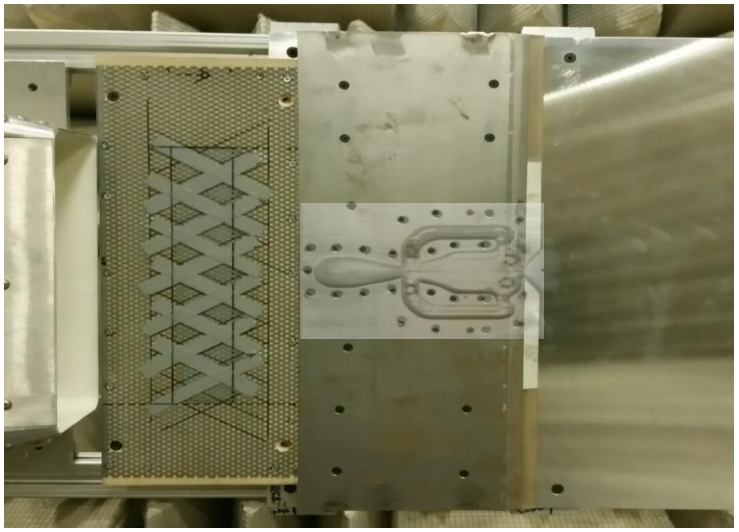


NASA Acoustics Technical Working Group Mtg, GRC, Oct. 25-26, 2016

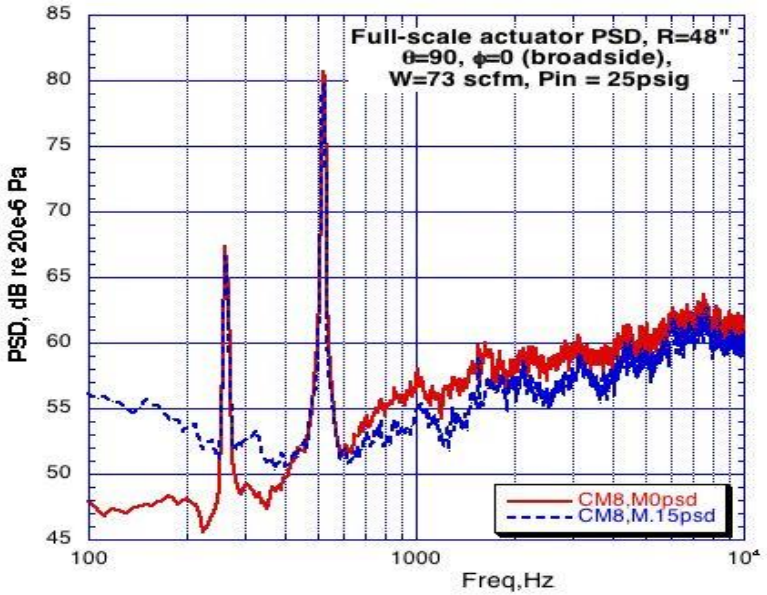
Topics

- AFC Sweeping Jet Acoustic Source
- Windscreen optimization
- In-Flow Reference Array/Source (INFRA/S) development status and plans

AFC Sweeping Jet Acoustic Studies



Single full-scale actuator on nozzle wall plate in ARC anechoic chamber

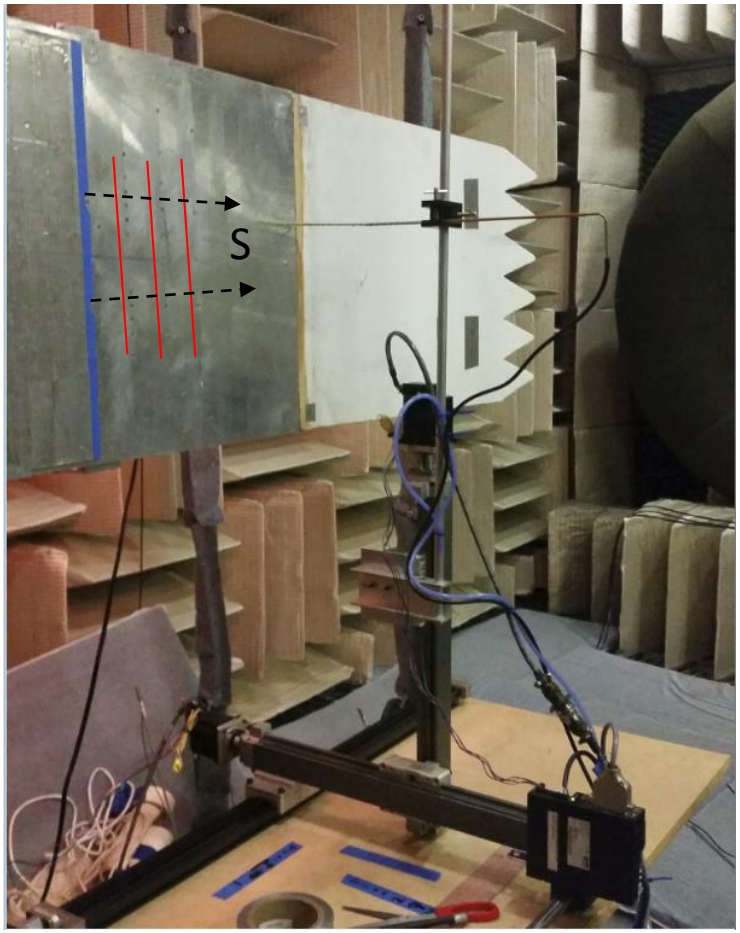


Single full-scale actuator on nozzle narrow band spectrum, M=0(red), M = 0.15 (blue

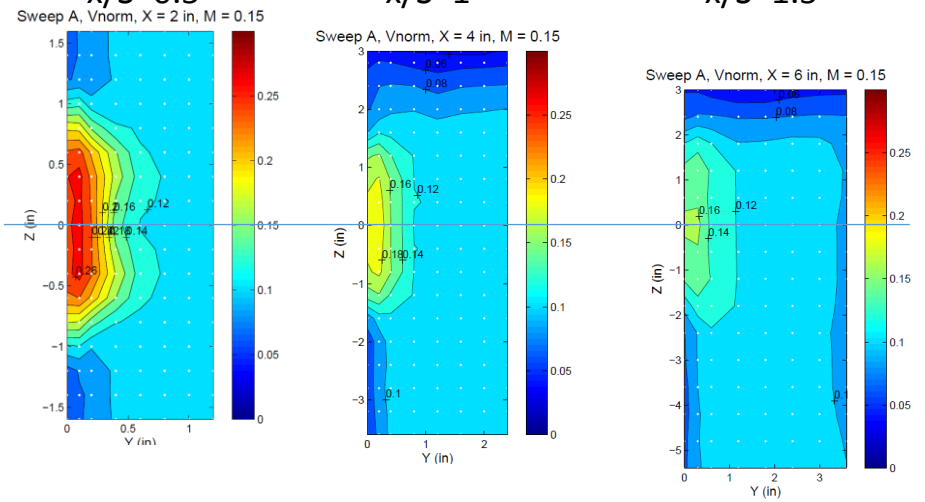
- Acoustic results presented at AIAA Aeroacoustics Conf. Lyon, 6/16
- Planned studies for FY17 include acoustic survey of sweeping jet actuator with zero wall length to compare with C. Hunter simulation
- Will support FY17-18 14x22 High-Lift AFC study with anechoic chamber acoustic measurements of AFC actuator

Velocity Profiles from Total Pressure Surveys

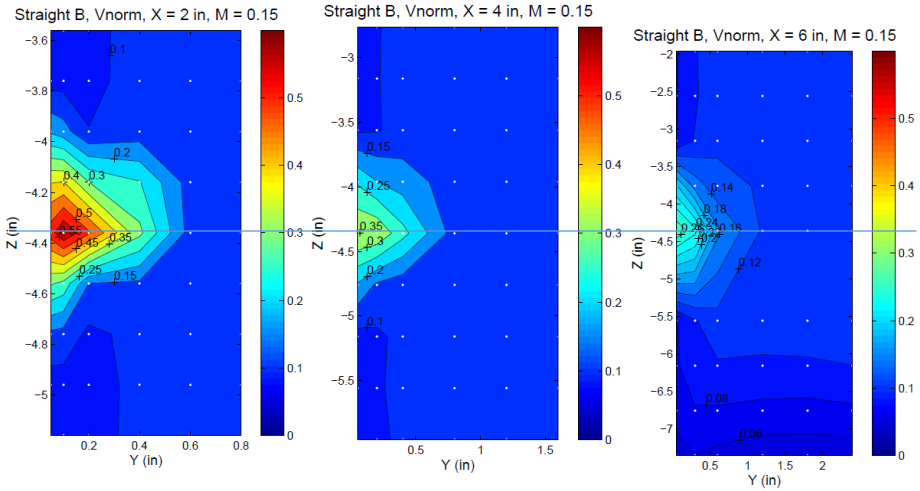
- Velocity scaled by average exit value for the configuration, max at $x/W_J = 2$
- Spatial scale increases linearly with downstream distance
- Dual actuator profile surveys completed: independent, in-/out-of-phase



x/S=0.5 x/S=1 x/S=1.5



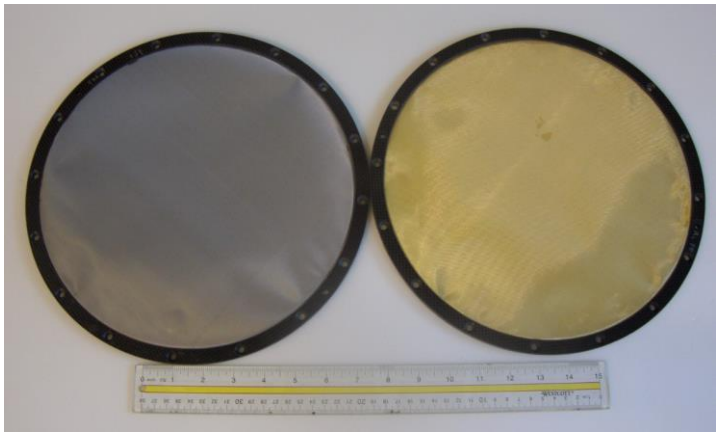
Single Sweep Jet

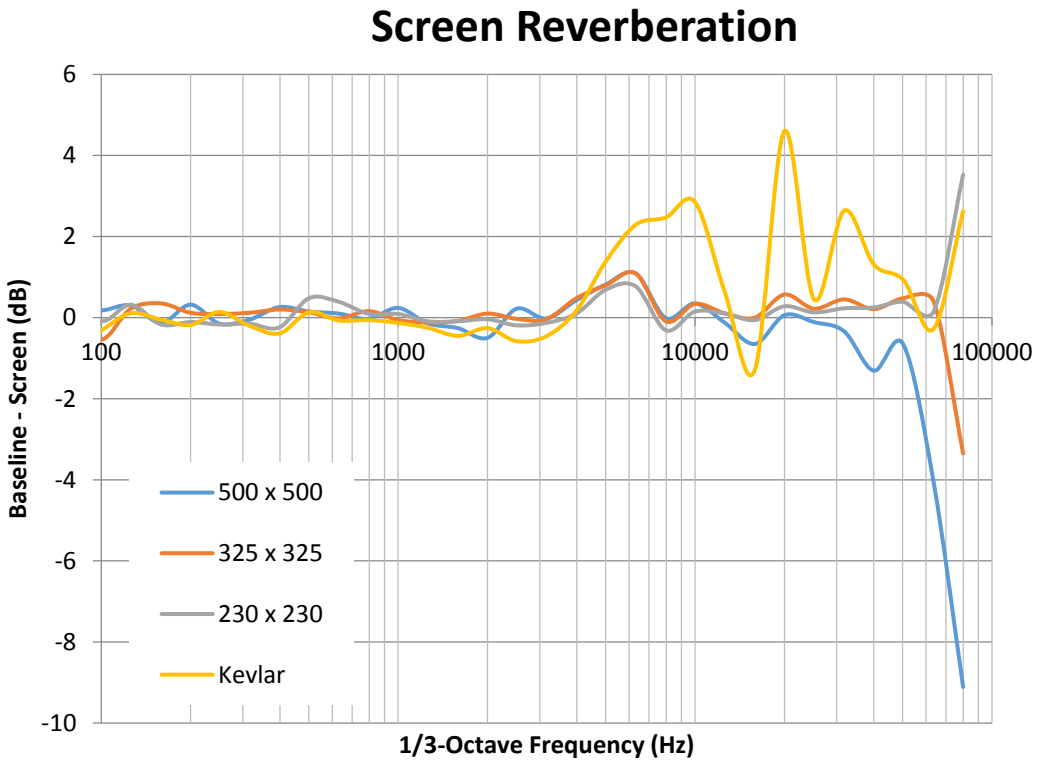


Single Non-Sweep Jet

(Plot size scale grows with downstream distance)

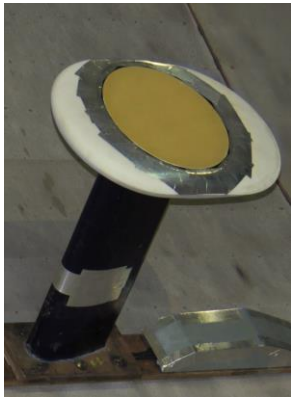
Array Windscreen Optimization Study



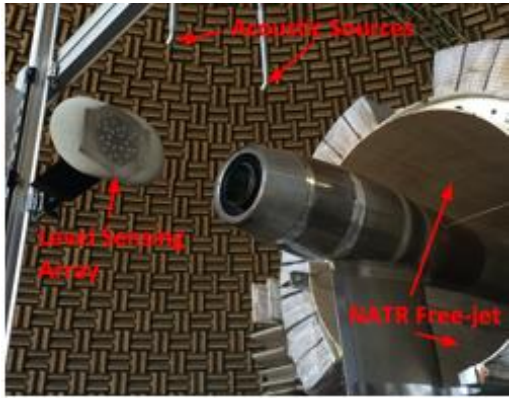


- Set up nozzle wall mounted array in anechoic chamber
- Tested Kevlar and stainless windscreens of various flow resistances for reverberation and flow noise
- 325x325 stainless tested by Podboy was best performer
- Anechoic chamber 4”x10” jet testing produced flow/frequency-related beamform artifact not observed in wind tunnel testing with strut mounted fairing

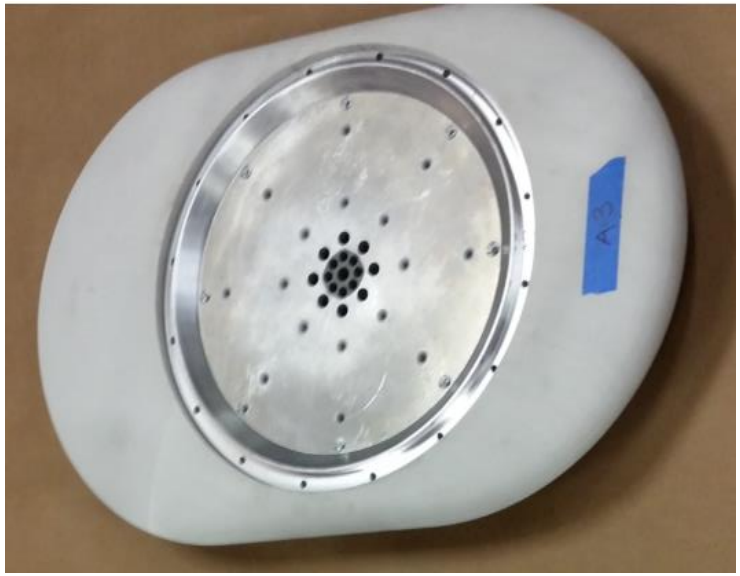
In-Flow Reference Arrays



ARC array in 40x80



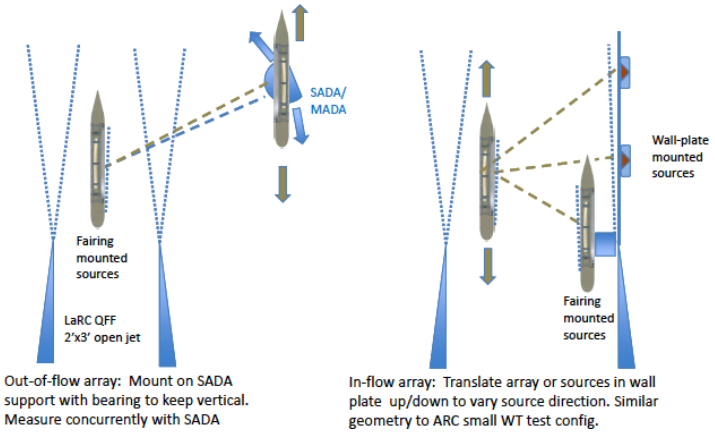
GRC array in NATR



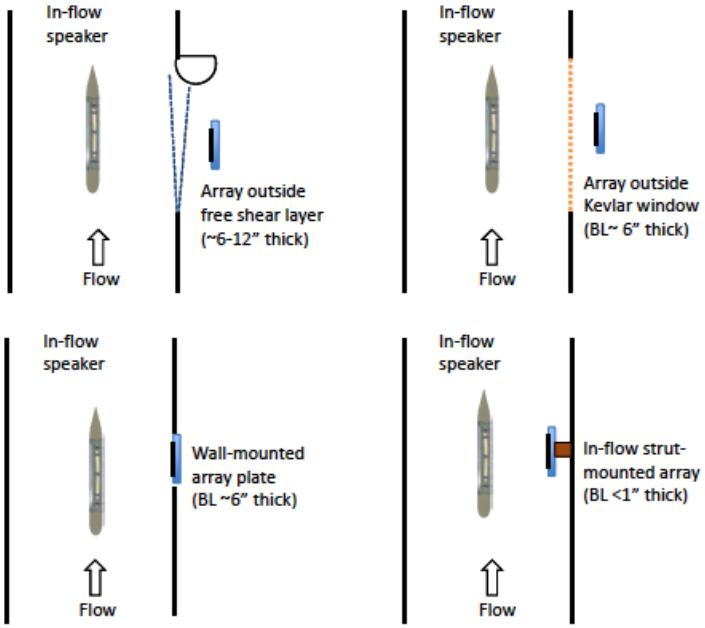
New LaRC array with SADA 33 element pattern

- 8”D, 24 element array in 21” x 14” x 2” fairing tested at ARC, GRC, with 10-20 dB S/N (1-30 kHz) improvement in acoustic level measurements
- 3rd array built at ARC for LaRC QFF, accommodates LARC SADA 33 element pattern and ARC 24 element pattern
- SADA pattern required adding 1” to fairing depth and modificaiton to lower fairing
- Use common in-flow design at ARC, GRC, LaRC to improve accuracy of in-flow level measurements, diagnose and reduce facility noise

In-Flow Reference Arrays: Planned FY17



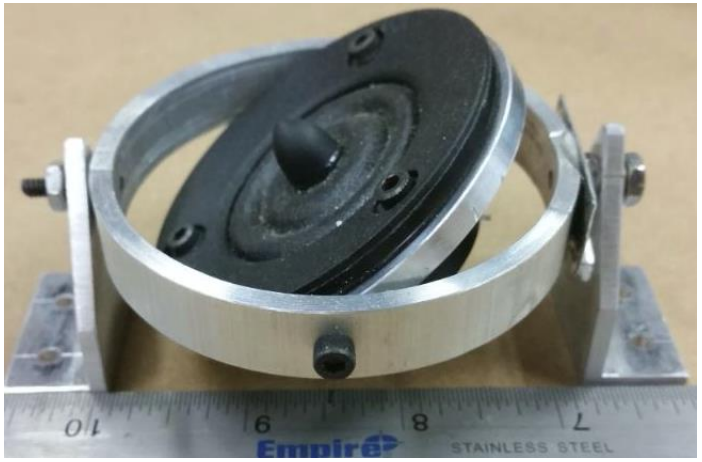
LaRC QFF test configurations



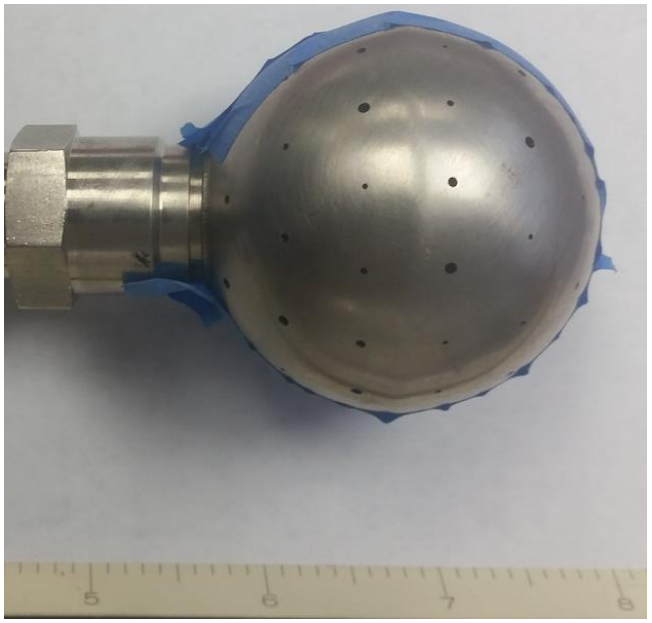
ARC 7x10 test configurations

- LaRC QFF comparison of exisiting out-of-flow SADA pattern with in/out of flow fairing array
- ARC 7x10 assessment of level measurement accuracy for 4 typical array installations:
  - out-of-flow measurement through shear layer, porous screen
  - In-flow wall/strut mount measurement
- GRC NATR testing to assess reference sources, level measurement accuracy

In-flow Reference Source Development



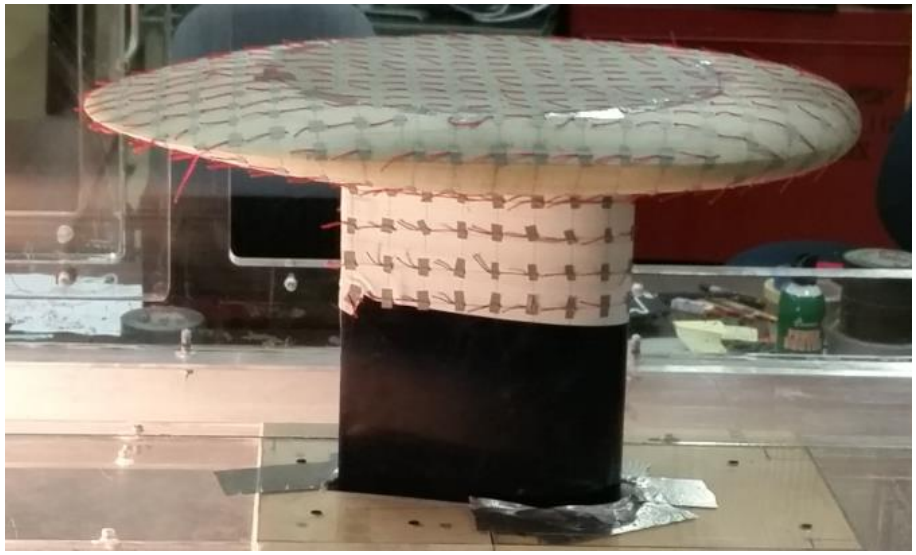
1.5” tweeter, 0.8-40 kHz



2”D airball, 1-100 kHz

- Each center has used facility-specific acoustic reference sources for array performance validation
- ARC measured directivities of 2 isolated broadband sources: 1.5” 25W tweeter, and 2”D airball. Preliminary results sent to LaRC and GRC
- These (and other) sources can be housed in fairing for validation of array level measurement accuracy

In-flow Reference Source Development



Orig. ARC array, variable strut height (3”, 6”)

3 new source fairings with dual speaker mounts

- Conducted aero performance measurements of original and modified fairings in ARC FML low-speed wind tunnel
- Fabricated 3 new deep fairings, wind screens with single/dual speaker mounts for FY17 testing at ARC, LaRC and GRC.

ARC FY17 Plans

- Support high-lift AFC configuration acoustic measurements
- Conduct in-flow reference array/source development, in ARC Army 7x10 WT, support efforts at GRC/ARC
- Further optimization of 2”D airball to improve omni-directionality for use as in-flow reference source
- Assess current design level measurement accuracy, further optimization if needed to achieve +/- 0.5 dB with documented improvement in S/N.